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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Moshe Rock et al.
Serial No. : 09/624,660
Filed : July 25, 2000
Title : PLAITED DOUBLE KNIT FABRIC WITH MOISTURE MANAGEMENT AND IMPROVED THERMAL INSULATION

Art Unit : 1771
Examiner : Norca Liz Torres Velazquez

Mail Stop Appeal Brief - Patents,
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

REPLY BRIEF

Pursuant to 37 C.F.R. § 41.41, Appellant responds to the Examiner's Answer as follows.

A. Brief History:

Appellants filed a Notice of Appeal on April 26, 2004, and an Appeal Brief on June 25, 2004. In response to Appellants' Appeal Brief, the Examiner reopened prosecution, mailing a further office action on September 22, 2004 raising new grounds of rejection. Appellants then requested that the appeal be reinstated, filing a Supplemental Brief on Appeal on January 24, 2005. This paper is in response to the Examiner's Answer mailed on September 9, 2005.

Appellants note, while the Examiner asserts that the "Status of Claims" and "Grounds for Rejection" are incorrect, apparently the Examiner is referring to the original Appeal Brief. These sections were updated in the Supplemental Brief on Appeal, to reflect the new grounds of rejection from the post-appeal Examiner's action and the cancellation of claims 19-32, and are believed to be correct.

CERTIFICATE OF MAILING BY FIRST CLASS MAIL

I hereby certify under 37 CFR §1.8(a) that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage on the date indicated below and is addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

October 27, 2005
Date of Deposit

Darlene J. Morin
Signature

Darlene J. Morin
Typed or Printed Name of Person Signing Certificate

B. The Invention:

Claims 1-8 and 10-18 all feature a composite textile fabric that includes an inner fabric layer and an outer fabric layer, which are formed concurrently by knitting a plaited construction. Both the inner fabric layer and outer fabric layer are made of yarns having a plurality of fibers of polyester or other synthetic yarn that have been rendered hydrophilic. Particles of a refractory compound are embedded within the plurality of yarn fibers of the inner fabric layer. The inner fabric layer has a surface area enlarged by a raising process. This creates air spaces among the fibers, enhancing insulation performance and reducing contact of the inner fabric layer, and consequently the refractory particles embedded in the inner fabric layer, upon a wearer's skin. By implication, since the inner layer is nearest to the wearer, in the claimed fabric substantially all of the refractory particles are worn away from the wearer's skin rather than touching the skin.

C. The Sole Issue:

The sole issue in this matter is whether TOSHIO describes a raised fabric article in which the refractory particles of the inner fabric layer are worn away from the human body, i.e., away from the wearer's skin. The Examiner maintains that TOSHIO discloses motivation "to wear the refractory particles away from the human body." (Examiner's Answer, section 9, page 5, full paragraph 2). The Examiner relies on the following except from the PTO translation of TOSHIO:

> "In particular, when knitted and woven fabric in which moisture-absorbing fibers such as cotton and wool are used as pile yarns and a binder containing far-infrared radioactive inorganic particles is given to the hair tips of the pile yarns are worn while placing said hair tip part toward the side opposite to the human body, the human body is effectively kept warm, and the blood vessels are expanded by the permeation of far-infrared rays into the deep skin part, so that the blood circulation is improved." (See TOSHIO, paragraph bridging pages 13 and 14; for convenience, attached as Exhibit A.)

Appellants respectfully assert that there is no teaching or suggestion in TOSHIO that would have led the artisan to modify Fujiwara and Lumb to include an inner layer as claimed by

Appellants. Moreover, we maintain that the Examiner's interpretation of the quoted excerpt of the translation from TOSHIO is not correct. Our reasons follow.

D. Arguments:

1. TOSHIO considered as a whole does not support the Examiner's proposed interpretation of the cited excerpt:

TOSHIO, when considered as a whole, even using the PTO translation (Exhibit A), contradicts the Examiner's proposed interpretation of the cited excerpt.

In all of the embodiments described by TOSHIO, refractory particles are disposed to be in direct contact with the wearer's skin. This is clear because TOSHIO repeatedly explains that the refractory particles are sprayed onto the surface of the raised pile and thereby adhered to the hair tip parts, which would contact the wearer's skin. See, for example, the following passages from the PTO translation:

"The present invention solves these problems, and the pile is knitted and woven fabrics to which the far-infrared radioactive inorganic particles [the refractory particles of Appellants' claims] *are given* [sic] *are worn while setting the hair tips to the inside, so that excellent insulation and medical effects are obtained."* (Page 4, emphasis provided).

"In Fig. 1, "binders (5) containing far-infrared radioactive inorganic particles are adhered to the hair tip parts (4)," i.e. the particle of refractory compound are applied only to the pile surface of the fabric." (Page 7, description of Figures.)

"A [single] *pile knitted fabric was formed... A solution of the* [particles of refractory compound] *was sprayed ... on the pile surface of the pile knitted fabric. ... Using the raw fabric, a vest and an inner sole of a shoe were made."* (Example 2, pages 9-10). (While no irrefutable descriptions of use of the insulating vest and inner sole of a shoe are provided by TOSHIO, in both instances it can reasonably be assumed that the single pile (raised fleece) surface, rather than the backing surface, would be worn facing towards a wearer's skin for comfort.)

In each of the passages quoted above, when the fabric is in use, a surface sprayed with particles of refractory compound would be in contact with the skin surface of the wearer.

While it is true that in some embodiments TOSHIO also includes refractory particles coated on the outer surface of the fabric, e.g., as shown in Fig. 2 and described in Examples 1, 3, and 4, in each case there is also an inner surface of the fabric sprayed with particles of refractory compound that would be in contact with the skin surface of the wearer. There is simply no teaching or suggestion that it would be desirable to provide a fabric in which substantially all of the refractory particles are worn away from the wearer's skin. Whatever the purpose of the refractory particles sprayed on the back surface of the fabric, it is nonetheless clear that having refractory particles in contact with the wearer's skin is considered essential by TOSHIO.

In the four examples provided by TOSHIO, three examples describe application of particles of refractory compound to both surfaces, and the fourth example describes application of the particles of refractory compound to the single pile surface for clothing/footwear articles for which it may be reasonably expected that the single raised surface, and, coincidentally, the only surface to which the particles of refractory compound are applied, in use would be positioned for contact with the wearer's skin. Thus, these teachings clearly do not support the Examiner's proposed interpretation of the excerpt cited above.

In response to the comment at page 7 of the Examiner's Answer, it is noted that the claims of TOSHIO are directed to method of manufacture, without any mention of use.

2. An independent certified translation of TOSHIO does not support the Examiner's proposed interpretation of the cited excerpt:

Appellants obtained a full certified translation of TOSHIO (submitted previously, with Appellants' Supplemental Brief on Appeal and, for convenience, attached as Exhibit B). The translation of the relevant section reads as follows;

> In particular, if absorbent fibers like cotton or wool are used as the pile yarn and binder containing inorganic granules with far-infrared radiation characteristics is affixed to the tips of the pile yarn, then, *when those fiber tips are worn so that they come into contact with the body, they have a especially good heat retaining effect.* The far-infrared radiation penetrates to the deepest areas of the skin and extends to the blood vessels, improving blood flow, so the warming effect is not merely local, but warms the entire body. (Exhibit A, p. 458, last full paragraph. *Emphasis added.*)

This independent translation does not support the Examiner's proposed interpretation of TOSHIO. Instead, it supports the Appellants' position that contact of the refractory particle coated fiber tips with the wearer's skin is an essential feature of TOSHIO's fabric.

3. The dictionary definition of "opposite" used as a preposition does not support the Examiner's proposed interpretation of the excerpt from TOSHIO:

The Examiner apparently contends that the phrase "opposite to the human body," used in the excerpt of the PTO translation, means "away from the human body." Appellants respectfully disagree.

In Webster's New Collegiate Dictionary (G. & C. Merriam Co., 1980), the first-listed definition for the word "opposite" used as a preposition (as in the cited excerpt) is "1: across from and usually facing or on the same level with (sat ~ each other)." This definition of the word "opposite" is in accord with disclosure of TOSHIO taken as whole, and contrary to the interpretation proposed by the Examiner.

E. Conclusion:

TOSHIO, taken as a whole, and, in particular, in the excerpt cited by the Examiner, does not suggest a raised fabric article in which the refractory particles of the inner layer are worn away from the human body, i.e., away for the wearer's skin. Therefore, claims 1-8 and 10-18 are not rendered obvious over the cited prior art.

For these reasons, and the reasons stated in the Supplemental Appeal, Appellants submit that the final rejection should be reversed.

Please apply any charges or credits to Deposit Account No. 06-1050, referencing Attorney Docket No. 10638-037001.

Respectfully submitted,

Date: October 27, 2005

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Japanese Patent

Document No. Hei 2-182968

METHOD FOR MANUFACTURING PILE KNITTED AND WOVEN FABRICS WITH EXCELLENT INSULATION

[Hoonsei No Sugureta Pairu Amiorimono No Seizoho]

Toshio Ozawa and Shozo Aono

UNITED STATES PATENT AND TRADEMARK OFFICE

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English Title	:	METHOD FOR MANUFACTURING PILE KNITTED AND WOVEN FABRICS WITH EXCELLENT INSULATION

/1[1]

Specification

1. Title of the invention

Method for Manufacturing Pile Knitted and Woven Fabrics with Excellent Insulation

2. Claims

1. A method for manufacturing pile knitted and woven fabrics with excellent insulation, characterized by the fact that the hair tip parts of pile knitted and woven fabrics are sufficiently divided and opened; and a binder containing far-infrared radioactive inorganic particles is sprayed on said hair tip parts.

2. The method for manufacturing pile knitted and woven fabrics with excellent insulation of Claim 1, characterized by including one or two or more far-infrared radioactive inorganic powders selected from a group comprised of zirconium oxide, cobalt oxide, iron oxide, manganese oxide, copper oxide,

[1] Numbers in the margin indicate pagination in the foreign text.

titanium oxide, silicon oxide, silicon carbide, chromium oxide, and aluminum oxide.

3. Detailed explanation of the invention

(Industrial application field)

The present invention pertains to a method that adheres far-infrared radioactive inorganic particles to the hair tips of pile knitted and woven fabrics.

(Prior art)

Pile knitted and woven fabrics are generally composed of natural fibers such as cottons and wools and synthetic fibers such as acryl fibers and polyester fibers. These pile knitted and woven fabrics are usually required to have insulation, and for example, the insulation is improved by lengthening the length of the pile or improving the density, especially mixed-spinning wools with good insulation at high efficiency. However, there is a limit in the improvement of the insulation, and a special measure is required to overcome the limit.

On the other hand, it is known that far-infrared radioactive inorganic particles are adhered to cloths for body thermotherapy and insulation. However, it is not known that the far-infrared radioactive inorganic particles are adhered to the pile knitted and woven fabrics. In particular, it is known that

these particles are given only to the hair tip parts of the pile knitted and woven fabrics.

(Problems to be solved by the invention)

However, it is not easy to uniformly and strongly adhere the far-infrared radioactive inorganic particles with poor adhesion such as sand particles only to the hair tip parts of the pile knitted and woven fabrics.

The present invention solves these problems, and the pile knitted and woven fabrics to which the far-infrared radioactive inorganic particles are given are worn while setting the hair tips to the inside, so that excellent insulation and medical effect are obtained.

(Means to solve the problems)

In order to achieve the above-mentioned purpose, the present invention is characterized by the fact that the hair tip parts of pile knitted and woven fabrics are sufficiently divided and opened and a binder containing far-infrared radioactive inorganic particles is sprayed on said hair tip parts.

As the material of the pile knitted and woven fabrics to which the present invention is applied, natural fibers such as cotton and wool, synthetic fibers such as acryl fibers and polyester fibers, or these mixed-spun and union-knitted products are used, and in terms of insulation and sense of wearing,

moisture-absorbing fibers such as cotton and wool are preferable. The knitting and weaving structures of the pile knitted and woven fabrics are not particularly limited, and the piles are also either a loop shape or a fiber-open shape.

The far-infrared radioactive inorganic particles being used in the present invention are ceramic particles for radiating far-infrared rays with a wavelength of 4-25 μ having the best efficiency to the human body at a temperature near the body temperature. For example, one kind or a mixture of two kinds or more of cobalt oxide, iron oxide, zirconium oxide, manganese oxide, copper oxide, titanium oxide, silicon oxide, silicon carbide, chromium oxide, aluminum oxide, and silicon carbide, etc., is used. These inorganic particles are used as a sintered body with betalite, cojelite, mullite, clay, etc. The size of these inorganic particles is preferably 0.1-30 μ.

Also, these inorganic particles are used by mixing with a binder, and as the binder, resins with soft hand and good adhesion with the piles of the pile knitted and woven fabrics, for example, urethane group elastomer resin and acrylic ester group resin are used. They are used by dissolving in a solvent such as toluene and ordinarily, emulsifying and diluting it with water.

In spraying the above-mentioned binder containing the inorganic particles, it is necessary to sufficiently open the pile surface of the pile knitted and woven fabrics, especially the hair tip parts. Next, the binder mixed with the above-mentioned far-infrared radioactive inorganic particles is adhered to the hair tip parts of said pile knitted and woven fabrics by spraying, and at that time, a consideration is preferably taken so that the hair tips may not be adhered to each other.

After spraying the binder, if necessary, a lubricant such as amino-modified silicone resin oil is sprayed on the above-mentioned pile knitted and woven fabrics to improve the slip, and finishing processes such as hair dividing, polishing, and hair shearing are further applied to the fabric.

Also, if necessary, the above-mentioned inorganic particle-included binder may be further rendered to the back face of the pile knitted and woven fabrics. Its means may be a spray method or an ordinary back pasting method.

The structures of the pile knitted and woven fabrics to which the far-infrared radioactive inorganic particles are given are explained using examples shown in the figures. Figures 1 and 2 are respectively enlarged cross sections showing the structure of pile knitted and woven fabrics obtained by the

method of the present invention. In Figure 1, pile yarns (3) are inserted into a fabric structure woven by warps (1) and wefts (2), and binders (5) containing far-infrared radioactive inorganic particles are adhered to the hair tip parts (4).

Also, in Figure 2, the binders (5) containing far-infrared radioactive inorganic particles are adhered to the hair tip parts (4) of the pile yarns (3) similarly to Figure 1, and the binder layer (6) containing far-infrared radioactive inorganic particles is also installed on the back face of the fabric structure.

Next, the present invention is further explained by application examples.

(Application examples)

Application Example 1

In the manufacture of a double-faced wool pile woven fabric, 100% acryl fibers (2/52) were used as base warps, 100% polyester fibers (30/2) were used as base wefts for drawing out the pile, and 100% anti-crimp wools (2/32) were used as pile yarns. Yarns with a twisting coefficient of α = 67 and the upper and lower ratio of 55% were used, the pile length was 6 mm in the surface and 6.5 mm in the back face, and the injection density was set to 50 pieces/inch. The base warps were fed through a dropper at only the lower part, and the pile yarns

were passed through a driving roller and an auxiliary roller, passed through the dropper and a belt, fed to a double weaving part, and woven by 10% structure. The pile yarns hanged over the woven fabric were cut at its central part, so that two sheets of pile woven fabric were prepared. The Metsuke of the raw fabric was 864 g/m. The piles were drawn out by extracting the wefts of the back face of the raw fabric, so that a double-faced pile woven fabric was formed. The woven fabric was dyed with a beige color by an acid dye using a wince dyeing /3 machine, softened, and dried by a tumbler dryer. Then, the hairs of both the surface and the back face were sufficiently divided, and the surface area was increased by opening the fibers of the pile parts.

On the other hand, a metal oxide mixture of 60% MnO_2, 20% Fe_2O_3, 10% CuO, and 10% CoO was temporarily baked at 1,200°C, and 30% of the temporarily baked product was mixed with cojelite, and baked at 1,150°C, and crushed at 1-20 μ, so that an inorganic powder was formed. 15% of the inorganic powder, 30% urethane resin, 15% acrylic ester resin, and 40% water were mixed and stirred, so that a raw solution for treatment was prepared.

Water was added at a ratio of the raw solution and the water of 1:1 to the raw solution, dispersed and mixed, sprayed at an apparent amount of 200 g/M on the surface of the pile

woven fabric, extended by a tenter, and dried. Furthermore, a treatment similar to the above-mentioned treatment was also applied to the back face of the pile woven fabric, and the hairs of the surface and the back face of the raw fabric were divided and sheared, so that a double-faced wool fabric was obtained. In the double-face wool fabric, in addition to the insulation of the main body of the wool, the improvement of the sensible temperature due to the far-infrared radiation of the attached inorganic powder was recognized, so that the blood circulation was increased.

Application Example 2

Acryl group fibers (1/14) were used as pile yarns, and acryl fibers (1/52) were used as base yarns. A pile knitted fabric was formed at a drawing of 38 mm and a density of 13 by a 16G seal milling cutter machine, and the hairs of the pile surface were sufficiently divided and opened.

On the other hand, 15% of the same inorganic powder as that of Application Example 1 for radiating far-infrared rays, 30% urethane resin, 10% toluene, 20% acrylic ester, and 25% water were mixed and stirred, so that a raw solution was prepared. Acrylic ester resin and water were added to the raw solution at a ratio of 1.5:1:1, mixed and stirred, sprayed at a ratio of 300 g/m (apparent amount) on the pile surface of the pile knitted

fabric by a nozzle, extended by a tenter, and dried. The piles of the raw fabric were divided, polished at 140-100°C four times by a polisher, and the pile tips were sheared and polished. As a result, a pile knitted fabric with a Metsuke of 450 g/m was formed. Using the raw fabric, a vest and an inner sole of a shoe were made. The vest had an effect as an insulating vest. In other words, the attached inorganic powder is warmed by the body temperature, and the far-infrared rays are radiated, so that the insulation effect is improved. On the other hand, the inner sole of the shoe obtained a sense of refreshing and drying by the effect of the far-infrared radioactive inorganic powder, without wetting the foots.

Application Example 3

Bulky yarns of acryl fibers (2/32) were used as pile yarns, and paralleled yarns of acryl fiber (1/52) yarns and polyester (150d) processed yarns were used as base yarns. A pile knitted fabric was formed at a drawing of 19 mm and a density of 12 by a seal milling cutter machine.

On the other hand, 20% of the same inorganic powder as that of Application Example 1 for radiating far-infrared rays, 35% urethane resin, 10% toluene, 10% acrylic ester, and 35% water were mixed and stirred, so that a raw solution was prepared. Acrylic ester resin and water were added to the raw solution at

a ratio of 1:1:1, mixed and stirred, sprayed at an apparent amount of 300 g/m on the back face of the knitted fabric, extended by a tenter, and dried. The piles of the raw fabric were sufficiently loosened by a hair divider, and water mixed and stirred at a ratio of the raw solution of the above-mentioned inorganic powder and the water of 1:2, sprayed at an apparent amount of 300 g/m on the pile surface of the knitted fabric, extended by a tenter, and dried. The pile parts of the raw fabric were re-divided and loosened, and the tips of the pile yarns were sheared. Using the raw fabric, an insulating vest was prepared. As a result, the attached far-infrared radioactive inorganic powder was warmed by the body temperature. On the other hand, the pile knitted fabric in which the hairs were loosened was dried again by a tumbler, formed as a pad-shaped knitted fabric, and used as an inner sole of a shoe. As a result, a refreshing and drying effect was recognized.

Application Example 4

Similarly to Application Example 1, tip-dyed cotton yarns (30/2) as pile yarns, cotton yarns (40/2) as base warps, and 100% polyester (40/2) as base weft yarns were used, and a double-faced pile woven fabric with a wing of 22, a 12% structure, a pile length of 3 m/m, and an injection of 62

pieces/in was prepared. The Mestsuke of the raw fabric was 669 g/m.

On the other hand, 15% of the same inorganic powder as that of Application Example 1 for radiating far-infrared rays, 30% urethane resin, 15% acrylic ester resin, and 40% water were mixed and stirred, so that a raw solution was prepared. /4

Acrylic ester resin and water were dispersed and mixed with the raw solution at a ratio of 1:1:1, sprayed at an apparent amount of 300 g/m on the surface and the back face of the above-mentioned double-faced pile woven fabric (before drawing the wefts), extended, and dried.

Then, the piles of the surface were drawn out to the back face by drawing four pieces out of 12 pieces of the polyester wefts (40/2) of the back face of the double-faced pile woven fabric sprayed.

The inorganic powder for radiating far-infrared rays remained in an adhered state to the base yarns, and a sandwich was formed by inserting the surface and back pile cottons. The surface and the back face of the piles were divided, sheared, and finished. 100% double-faced cotton fabric was obtained by cutting the finished fabric into 200 cm. This wool fabric improved the sensible temperature by the far-infrared radiation

of the attached inorganic oxide, and the blood circulation was improved.

(Effects of the invention)

As mentioned above, according to the present invention, for pile knitted and woven fabrics composed of any of natural fibers, recycled fibers, and synthetic fibers, far-infrared radioactive inorganic particles can be uniformly and strongly given to the hair tip parts of the piles.

Then, the pile knitted and woven fabrics to which the far-infrared radioactive inorganic particles are given are effectively used for vests, liners of coats, mats for preventing a floor slip, inner soles of shoes, hot carpet cover sheets, etc., and can also be uniformly and softly given to interior sleeping goods such as sleeping sheets and double-faced blanks. Thus, a wide utilization value is recognized in the present invention.

In particular, when knitted and woven fabric in which moisture-absorbing fibers such as cotton and wool are used as pile yarns and a binder containing far-infrared radioactive inorganic particles is given to the hair tips of the pile yarns are worn while placing said hair tip part toward the side opposite to the human body, the human body is effectively kept warm, and the blood vessels are expanded by the permeation of

far-infrared rays into the deep skin part, so that the blood circulation is improved. Thereby, the entire human body as well as the local parts is warmed. Also, since moisture such as sweat being dispersed from the human body surface permeates into the hydrophobic binder part and is absorbed in the moisture-absorbing fiber part of the deep pile part, the part in contact with the skin has a very good sense of refreshing.

4. Brief description of the figures

Figures 1 and 2 are enlarged cross sections showing the structure of pile knitted and woven fabrics obtained by the method of the present invention.

1 Warp

2 Weft

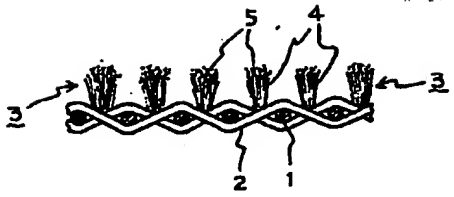
3 Pile yarn

4 Hair tip part

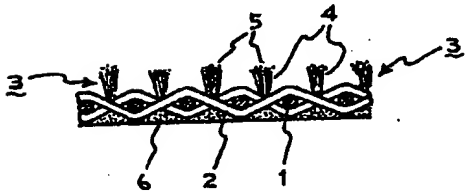
5 Binder

6 Binder layer of the back face of knitted and woven fabrics

第１図



第２図



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(54) Title of the Invention: MANUFACTURING METHOD FOR KNITTED/WOVEN PILE WITH SUPERIOR HEAT RETENTION

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Specification

1. Title of the Invention: MANUFACTURING METHOD FOR KNITTED/WOVEN PILE WITH SUPERIOR HEAT RETENTION

2. Claims

Claim 1. A method for manufacturing knitted/woven pile with superior heat retention with the following features: The tips of the fibers in a knitted/woven pile are fully napped and opened, after which a binder containing inorganic granules that have far-infrared radiation characteristics are atomized and affixed to the tips.

Claim 2. The method for manufacturing knitted/woven pile with superior heat retention described in Claim 1 in which the pile contains 1 or 2 or more inorganic powders that have far-infrared radiation characteristics from among the following: zirconium oxide, cobalt oxide, iron oxide, manganese oxide, copper oxide, titanium oxide, silica oxide, silica carbide, chrome oxide, or aluminum oxide.

3. Detailed Description of the Invention

Industrial Fields of the Invention

This invention pertains to methods for affixing inorganic granules with far-infrared radiation characteristics to the tips of the fibers in knitted/woven pile.

Prior Art

Knitted/woven pile is generally made from natural fibers, such as cotton or wool or from synthetic fibers such as acrylic or polyester. Normally, good heat retention characteristics are important with knitted/woven pile of this sort, which can be improved by lengthening the pile or by increasing its density, for example. In particular, attempts have been made to improve heat retention characteristics by blending in higher rates of wool with excellent heat retention, but there are limits to the extent to which heat retention can be improved. Special techniques are required to go beyond these limits.

In other areas, such as thermal physical therapy, it is known that inorganic granules, with far-infrared radiation characteristics, can be affixed to clothing for the purpose retaining heat. However, no such technique is known for affixing inorganic granules to knitted/woven pile. In particular, there is no known method for affixing them to the tips of the fibers in knitted/woven pile.

Problems that the Invention Attempts to Solve

However, inorganic granules with far-infrared radiation characteristics are like sand and have poor adhesion. It is not easy to affix them, uniformly and securely, to just the tips of the fibers in knitted/woven pile.

This invention solves these problems. By wearing the resulting knitted/woven pile, to which inorganic

granules with far-infrared radiation characteristics have been affixed, superior heat retention and therapeutic effect are achieved.

Means for Resolving the Problems

In order to achieve the above objectives with this invention, the tips of the fibers in the knitted/woven pile are napped and fully exposed, after which a binder, containing inorganic granules with far-infrared radiation characteristics, is atomized onto the tips of the fibers in question.

Material that is suitable for use in this knitted/woven pile includes natural fibers, such as cotton or wool, and synthetic fibers like acrylic or polyester. Alternatively, mixes or blends of these materials could be used, but considering heat retention and comfort, wool or cotton would be desirable for their moisture absorption characteristics. There are no particular limitations on the way the knitted/woven pile can be knitted/woven together, and the pile could have loops or be an open weave.

Inorganic granules with far-infrared radiation characteristics that can be used in this invention include ceramic granules that radiate far-infrared radiation at wavelengths of 4 – 25 microns, which have the best efficiency for retaining heat around human body temperature. These include one or more of the following: cobalt oxides, iron oxides, zirconium oxides, manganese oxides, copper oxides, silicon oxides, titanium oxides, chrome oxides, aluminum oxides and silicon carbides. These inorganic granules are also used as sintered bodies in Bakelite, Cordierite, Murite and clay. The granularity of these inorganic granules should be between 0.1 and 30 microns.

Additionally, these inorganic granules are also used with binders. Candidate binders include those that have a soft texture or appearance and excellent adhesion to the knitted/woven pile. These include urethane elastomer resins and ester acrylate resins, which are dissolved in toluene or a similar solvent. These are then emulsified in water and diluted before use.

When atomizing the binders containing the inorganic granules described above, it is necessary that the surface of knitted/woven pile be fully open, especially at the tips of the fibers. Next, the binder with the inorganic granules and the far-infrared radiation characteristics described above is affixed to the knitted pile in question by atomizing it. When doing so, it is desirable to keep the tips of the fibers from adhering to each other.

After atomizing the binder, the knitted/woven pile described above could be treated with an atomized lubricant such as amino-denatured silicon resin oil, if necessary, to improve suppleness. Later, the fibers could be subjected to such processes as napping, polishing, or trimming.

Additionally, if necessary, the binder with the inorganic granules described above could also be affixed to the reverse side of the knitted/woven pile. This could involve atomization or normal glue backing application techniques.

Figures 1 and 2 show examples of magnified cross-sections of the structure of the resulting knitted/woven pile, to which inorganic granules with far-infrared radiation characteristics have been affixed. Figure 1 shows the warp yarn (1) and the weft yarn (2), which form the base structure and into which the pile fibers (3) have been inserted. Binder (5), containing inorganic granules with far-infrared radiation characteristics, has been affixed to the tips (4) of those fibers.

Additionally, in Figure 2, as in Figure 1, binder (5), containing inorganic granules with far-infrared radiation characteristics, has been affixed to the tips (4) of the pile fibers (3) and a binder layer (6), containing inorganic granules with far-infrared radiation characteristics has also been applied to the base structure.

Below we will explain this invention further using embodiments.

Embodiments

Embodiment 1

In a dual-sided woven wool pile sample, 100% (2/52) acrylic fiber was used as the warp yarn in the base while 100% (30/2) polyester fiber was used in the weft yarn in the base and in the pull warp yarn. The pile yarn was 100% (2/32) shrink-resistant wool. The twist factor, α, was 67, the yarn had an over-under ratio of 55%, the pile length was 6 mm on the front and 6.5 mm on the back and the needling density was 50 lines per inch. The base warp yarn was fed through a dropper only on the lower part and the pile yarn passed through a drive roller and an auxiliary roller before going through a separation spindle, dropper and holder, before being supplied to a dual-weave module where it was woven into a 10-division format. The pile yarn that is passed over to the woven base above and below is trimmed at the center, producing a two-layer woven pile. The weight of this fabric is 864 g/m. By pulling the loose warp yarn on the reverse side of this fabric through, the pile is exposed, resulting in a two-sided woven pile. Using a Wince dying device on this

woven fabric, we dyed the wool a beige color using an acid dye, softened it and dried it in a tumble dryer. Subsequently, we napped the fibers on the front and rear surfaces and increased the surface area of the pile using an open weave.

Meanwhile, we subjected a mixture of metal oxides (60% MnO_2, 20% Fe_2O_3, 10% CuO and 10% CoO) to preliminary sintering at 1200° C. We then mixed this partly sintered mixture (30%) with Cordierite and sintered it at 1150° C, after which we pulverized it into a fine powder of 1 – 20 microns. We then mixed 15% of this inorganic powder with 30% urethane resin, 15% ester acrylate resin and 40% water and stirred it to produce our base processing solution.

We added water at a rate of 1:1 to this base solution and, after diffusing and mixing it, we atomized it over the surface of the woven pile at a rate of 200 g/M (apparent amount) and sized on a tenter before drying it. We then processed the reverse side of the woven pile in the same manner as above and napped and trimmed the fibers on the front and back of this fabric, producing a two-sided wool blanket. In addition to the heat retention characteristics of the wool that made up the majority of this two-sided wool blanket, we found an improvement in the sensation of warmth, created by the far-infrared radiation characteristics of the inorganic powder that had been affixed, as well increased blood flow.

Embodiment 2

We used acrylic fiber (1/14) as the pile yarn, acrylic fiber (1/52) as the base yarn and, with a 16G seal flice machine, we drew out 38 mm and knitted the knit base for the pile with the setting at 13. We then napped and opened the fibers in the pile surface.

Meanwhile, as with Embodiment 1, we made our base solution by combining and stirring 15% powder, 30% urethane resin, 10% toluene, 20% ester acrylate and 25% water. One part of this base solution was mixed with 1.5 parts ester acrylate resin, and 1 part water, stirred and applied to the surface of the pile at the knitted base using a nozzle and a rate of 300 g/m (apparent amount). This was sized on a tenter and dried. We napped the fibers of this fabric and ran a polisher over it 4 times in a temperature range of 100 – 140° C. We then trimmed and finished the tips of the fibers. The result was knitted pile that weighed 450 g/m. We used this fabric to make a vest and insoles for shoes. The vest worked well as a heat-retaining vest. In other words, depending upon the body temperature, the inorganic granules would be warmed and radiate far-infrared radiation, improving the heat-retaining effect. Additionally, the effect of the inorganic granules with far-infrared radiation characteristics in shoe insoles to produce a clean fresh feeling without making the feet sweaty.

Embodiment 3

We used a bulky yarn as our pile yarn that was acrylic (2/32) fiber, an acrylic (1/52) fiber as the base yarn and a polyester (150d) processed yarn as the alignment yarn, we drew out 19 mm and knitted the fabric on a seal flice machine with the setting at 12.

Meanwhile, as with Embodiment 1, we made our base solution by combining and stirring 20% powder, 35% urethane resin, 10% toluene, 10% ester acrylate and 35% water. One part of this base solution was mixed with 1 part ester acrylate resin, and 1 part water, stirred and atomized onto the rear knitted surface at a rate of 300 g/m (apparent amount). This was then sized on a tenter and dried. After napping and finishing the fibers in the pile of this fabric sufficiently, we then combined 2 parts water to 1 part of the inorganic granule base solution described above and stirred them. We then atomized the solution on the front surface of the knitted pile at a rate of 300 g/m (apparent amount) and sized it on a tenter for drying. We re-napped and finished the pile on this fabric and then trimmed the tips of the pile fibers. This cloth was used to make a heat-retaining vest. The effect was that the inorganic granule powder with the far-infrared radiation characteristics was heated by the temperature of the body. We then finished the fibers again and dried the knitted pile in a tumble dryer. Used as a fleece insole for shoes, it kept the shoes comfortably dry and fresh.

Embodiment 4

As in Embodiment 1, we used a pre-dyed cotton yarn (30/2) in the pile fiber, cotton yarn in the base warp (40/2) and 100% polyester (40/2) in the base weft. We created a two-sided woven pile that had 22 rows, 12 divisions, a pile length of 3 m/m and a drive density of 62 units per inch. This weight of this fabric was 669 g/m.

Meanwhile, we made a base solution that emitted far-infrared radiation as with Embodiment 1, by combining and stirring 15% powder, 30% urethane resin, 15% ester acrylate and 40% water.

We stirred together 1 part of this base solution with 1 part ester acrylate resin and 1 part water and then atomized it onto the front and rear surfaces of the two-sided woven pile described above (before the weft yarn was pulled out) at a rate of 300 g/m (apparent amount) and then dried.

Subsequently, by pulling out 4 of the 12 polyester (40/2) lengths of weft yarn in the back of the atomized, two-sided, woven pile, we pulled the front side pile out to the back side.

The inorganic granules that emit far-infrared radiation were left where they had been affixed to the base yarn on either side of the front and back pile cotton, in the form of a sandwich. We napped, trimmed and finished the napping of these front and rear pile surfaces. We cut the finished bolt to 200 cm, producing a two-sided 100% cotton blanket. We found that the far-infrared radiation of the inorganic granules in this blanket, improved feelings of warmth and helped to make the blood circulate.

Effect of the Invention

As described above, this invention makes it possible to easily affix, uniformly and securely, inorganic granules, that have far-infrared radiation characteristics, to the tips of the pile fibers of any kind of knitted/woven fiber made of natural fiber, recycled fiber or synthetic fiber.

The resulting knitted/woven pile to which the inorganic granule with the far-infrared radiation characteristics have been affixed, could be used as linings in vests or coats, mats to prevent slipping, insoles, hot carpet covers or in similar goods. Because bedding and sheets can be given a uniform softness, it would be worthwhile to use it in two-sided blankets or other interior linen/bedding.

In particular, if absorbent fibers like cotton or wool are used as the pile yarn and binder containing inorganic granules with far-infrared radiation characteristics is affixed to the tips of the pile yarn, then, when those fiber tips are worn so that they come into contact with the body, they have a especially good heat retaining effect. The far-infrared radiation penetrates to the deepest areas of the skin and extends to the blood vessels, improving blood flow, so the warming effect is not merely local, but warms the entire body. Additionally, sweat or other moisture from the body's surface could pass through the water-dispersible binder to be absorbed by the fibers deep within the pile. This would give the part that comes into contact with the skin refreshing and very comfortable.

4. Brief Description of the Drawings

Figures 1 and 2 show enlarged cross sections of the structure of the knitted/woven pile produced using the methods of this invention.

1. Warp 2. Weft 3. Pile Yarn
4. Fiber Tips 5. Binder
6. Knitted/Woven Front/Rear Binder Layers

Patent Applicant: Toyo Kosan Co., Ltd.
Patent Applicant: Aono Pile Co., Ltd.

Figure 1

[see original for drawing]

Figure 2

[see original for drawing]

position ⟨~ sides of the question⟩ **b** : diametrically different (as in nature or character) ⟨~ meanings⟩ **3** : contrary to one another or to a thing specified : REVERSE ⟨gave them ~ directions⟩ **4** : being the other of a matching or contrasting pair : COMPLEMENTARY ⟨members of the ~ sex⟩ **5** : of, relating to, or being the side of a baseball field that is near the first base line for a right-handed batter and near the third base line for a left-handed batter ⟨hit a single to the ~ field⟩ — **op-po-site-ly** *adv* — **op-po-site-ness** *n*

syn OPPOSITE, CONTRADICTORY, CONTRARY, ANTITHETICAL *shared meaning element* : being so far apart as to be or seem irreconcilable. OPPOSITE, the inclusive term, may replace any of the others but finds its typical application in description of abstract things that stand in sharp contrast or complete antagonism ⟨held *opposite* views on the solution of the problem⟩ ⟨the boys went in *opposite* directions⟩ CONTRADICTORY applies to things that so completely negate each other that if one is true or valid the other must be false or invalid ⟨the suspects made *contradictory* statements to the police⟩ CONTRARY can imply extreme divergence (as of opinions or motives) or, especially as used in formal logic, diametrical opposition ⟨his conclusion was *contrary* to mine⟩ ⟨they drifted off in a *contrary* direction⟩ ANTITHETICAL stresses clear and unequivocal diametric opposition ⟨the essential interests of men and women are eternally *antithetical* —H. L. Mencken⟩

[3]opposite *adv* : on or to an opposite side

[4]opposite *prep* **1** : across from and usu. facing or on the same level with ⟨sat ~ each other⟩ **2** : in a role complementary to ⟨played ~ the leading man in the comedy⟩

opposite number *n* : a member of a system or class who holds relatively the same position as a particular member in a corresponding system or class ⟨union executives met with their *opposite numbers* in industry⟩

op-po-si-tion \ˌäp-ə-ˈzish-ən\ *n* **1** : a configuration in which one celestial body is opposite another in the sky or in which the elongation is near or equal to 180 degrees **2** : the relation between two propositions having the same subject and predicate but differing in quantity or quality or both **3** : an act of setting opposite or over against : the condition of being so set **4** : hostile or contrary action or condition **5 a** : something that opposes; *specif* : a body of persons opposing something **b** *often cap* : a political party opposing and prepared to replace the party in power — **op-po-si-tion-al** \-ˈzish-nəl, -ən-ᵊl\ *adj*

op-press \ə-ˈpres\ *vt* [ME *oppressen*, fr. MF *oppresser*, fr. L *oppressus*, pp. of *opprimere*, fr. *ob-* against + *premere* to press — more at OB-, PRESS] **1 a** *archaic* : SUPPRESS **b** : to crush or burden by abuse of power or authority **2** : to burden spiritually or mentally : weigh heavily upon — **op-pres-sor** \-ˈpres-ər\ *n*

op-pres-sion \ə-ˈpresh-ən\ *n* **1 a** : unjust or cruel exercise of authority or power **b** : something that oppresses esp. in being an unjust or excessive exercise of power **2** : a sense of being weighed down in body or mind : DEPRESSION

op-pres-sive \ə-ˈpres-iv\ *adj* **1** : unreasonably burdensome or severe ⟨~ legislation⟩ **2** : TYRANNICAL **3** : overwhelming or depressing to the spirit or senses ⟨an ~ climate⟩ ***syn*** see ONEROUS — **op-pres-sive-ly** *adv* — **op-pres-sive-ness** *n*

op-pro-bri-ous \ə-ˈprō-brē-əs\ *adj* **1** : expressive of opprobrium : SCURRILOUS ⟨~ language⟩ **2** : deserving of opprobrium : INFAMOUS — **op-pro-bri-ous-ly** *adv* — **op-pro-bri-ous-ness** *n*

op-pro-bri-um \-brē-əm\ *n* [L, fr. *opprobrare* to reproach, fr. *ob* in the way of + *probrum* reproach; akin to L *pro* forward and to L *ferre* to carry, bring — more at OB-, FOR-, BEAR] **1** : something that brings disgrace **2 a** : public disgrace or ill fame that follows from conduct considered grossly wrong or vicious : INFAMY **b** : CONTEMPT, REPROACH ***syn*** see DISGRACE

op-pugn \ə-ˈpyün, ä-\ *vt* [ME *oppugnen*, fr. L *oppugnare*, fr. *ob-* against + *pugnare* to fight — more at OB-, PUNGENT] **1** : to fight against : ASSAIL **2** : to call in question — **op-pugn-er** *n*

Ops \ˈäps\ *n* [L] : the Roman goddess of fertility and plenty and the wife of Saturn

op-sin \ˈäp-sən\ *n* [prob. back-formation fr. *rhodopsin*] : any of various colorless proteins that are formed with retinal by the action of light on a visual pigment (as rhodopsin)

-op-sis \ˈäp-səs\ *n comb form, pl* **-op-ses** \-ˌsēz\ *or* **-op-si-des** \-sə-ˌdēz\ [NL, fr. Gk, fr. *opsis* appearance, vision] : structure resembling a (specified) thing ⟨caryo*opsis*⟩

op-son-ic \äp-ˈsän-ik\ *adj* : of, relating to, or involving opsonin

op-so-nin \ˈäp-sə-nən\ *n* [L *opsonium* relish (fr. Gk *opsōnion* victuals, fr. *opsōnein* to purchase victuals) + E *-in* — more at OLIGOPSONY] : an antibody of blood serum that makes foreign cells more susceptible to the action of the phagocytes

-op-sy \ˌäp-sē, əp-\ *n comb form* [Gk *-opsia*, fr. *opsis*] : examination ⟨necro*psy*⟩

[1]opt \ˈäpt\ *vi* [F *opter*, fr. L *optare* — more at OPTION] : to make a choice; *esp* : to decide in favor of something ⟨~*ed* for a tax increase —Tom Wicker⟩

[2]opt *abbr* **1** optical; optician; optics **2** optional

op-ta-tive \ˈäp-tət-iv\ *adj* **1 a** : of, relating to, or constituting a verbal mood that is expressive of wish or desire **b** : of, relating to, or constituting a sentence that is expressive of wish or hope **2** : expressing desire or wish — **optative** *n* — **op-ta-tive-ly** *adv*

[1]op-tic \ˈäp-tik\ *adj* [MF *optique*, fr. ML *opticus*, fr. Gk *optikos*, fr. *opsesthai* to be going to see; akin to Gk *opsis* appearance, *ōps* eye — more at EYE] **1** : of or relating to vision or the eye **2** : dependent chiefly on vision for orientation

[2]optic *n* **1** : EYE **2** : any of the lenses, prisms, or mirrors of an optical instrument; *also* : an optical instrument

op-ti-cal \ˈäp-ti-kəl\ *adj* **1** : of or relating to the science of optics **2 a** : of or relating to vision : VISUAL ⟨an ~ illusion⟩ **b** : VISIBLE ⟨an ~ galaxy⟩ **c** : designed to aid vision ⟨an ~ instrument⟩ **3 a** : of, relating to, or utilizing light ⟨an ~ emission⟩ ⟨an ~ telescope⟩ ⟨~ microscopy⟩ **b** : involving the use of light-sensitive devices to acquire information for a computer ⟨~ character recognition⟩ **4** : of or relating to optical art — **op-ti-cal-ly** \-k(ə-)lē\ *adv*

optical activity *n* : ability to rotate the plane of vibration of polarized light to the right or left

optical art *n* : nonobjective art characterized by the use of straight or curved lines or geometric patterns often for an illusory effect (as of motion)

optical bench *n* : an apparatus that is fitted for the convenient location and adjustment of light sources and optical devices and that is used for the observation and measurement of optical phenomena

optical glass *n* : flint or crown glass of well-defined characteristics used esp. for making lenses

optical illusion *n* : ILLUSION 2a(1)

optical rotation *n* : the angle through which the plane of vibration of polarized light that traverses an optically active substance is rotated

optic axis *n* : a line in a doubly refracting medium that is parallel to the direction in which all components of plane-polarized light travel with the same speed

optic chiasma *n* [NL *chiasma* X-shaped configuration — more at CHIASMA] : the X-shaped partial decussation on the undersurface of the hypothalamus through which the optic nerves are continuous with the brain — called also *optic chiasm*

optic disk *n* : the nearly circular light-colored area at the back of the retina where the optic nerve enters the eyeball

op-ti-cian \äp-ˈtish-ən\ *n* **1** : a maker of or dealer in optical items and instruments **2** : one that grinds spectacle lenses to prescription and dispenses spectacles — compare OPHTHALMOLOGIST, OPTOMETRIST

optic nerve *n* : either of the pair of nerves that comprise the second pair of cranial nerves, arise from the ventral part of the diencephalon, supply the retina, and conduct visual stimuli to the brain — see EYE illustration

op-tics \ˈäp-tiks\ *n pl but sing or pl in constr* **1** : a science that deals with the genesis and propagation of light, the changes that it undergoes and produces, and other phenomena closely associated with it **2** : optical properties

op-ti-mal \ˈäp-tə-məl\ *adj* : most desirable or satisfactory : OPTIMUM — **op-ti-mal-i-ty** \ˌäp-tə-ˈmal-ət-ē\ *n* — **op-ti-mal-ly** \-mə-lē\ *adv*

op-ti-mism \ˈäp-tə-ˌmiz-əm\ *n* [F *optimisme*, fr. L *optimum*, n., best, fr. neut. of *optimus* best; akin to L *ops* power — more at OPULENT] **1** : a doctrine that this world is the best possible world **2** : an inclination to put the most favorable construction upon actions and events or to anticipate the best possible outcome — **op-ti-mist** \-məst\ *n* — **optimist** *or* **op-ti-mis-tic** \ˌäp-tə-ˈmis-tik\ *or* **op-ti-mis-ti-cal** \-ti-kəl\ *adj* — **op-ti-mis-ti-cal-ly** \-ti-k(ə-)lē\ *adv*

Op-ti-mist \ˈäp-tə-məst\ *n* [*Optimist* (*club*)] : a member of a major international service club

op-ti-mize \ˈäp-tə-ˌmīz\ *vt* **-mized; -miz-ing** : to make as perfect, effective, or functional as possible — **op-ti-mi-za-tion** \ˌäp-tə-mə-ˈzā-shən\ *n* — **op-ti-miz-er** \ˈäp-tə-ˌmī-zər\ *n*

op-ti-mum \ˈäp-tə-məm\ *n, pl* **-ma** \-mə\ *also* **-mums** [L] **1** : the amount or degree of something that is most favorable to some end; *esp* : the most favorable condition for the growth and reproduction of an organism **2** : greatest degree attained or attainable under implied or specified conditions — **optimum** *adj*

[1]op-tion \ˈäp-shən\ *n* [F, fr. L *option-*, *optio* free choice; akin to L *optare* to choose, Gk *epiopsesthai* to be going to choose] **1** : an act of choosing **2 a** : the power or right to choose : freedom of choice **b** : a privilege of demanding fulfillment of a contract on any day within a specified time **c** : a contract conveying a right to buy or sell designated securities or commodities at a specified price during a stipulated period; *also* : the right conveyed by an option **d** : a right of an insured person to choose the form in which payments due him on a policy shall be made or applied **3** : something that may be chosen: as **a** : an alternative course of action ⟨didn't have many ~s open to him in choosing a career⟩ **b** : an item that is offered in addition to or in place of standard equipment ⟨a car that includes air-conditioning and a V-8 engine among its ~s⟩ **4** : an offensive football play in which a back may choose whether to pass or run with the ball — called also *option pass*, *option play* ***syn*** see CHOICE

[2]option *vt* : to grant or take an option on

op-tion-al \ˈäp-shnəl, -shən-ᵊl\ *adj* : involving an option : not compulsory — **op-tion-al-ly** \-ē\ *adv*

op-to-ki-net-ic \ˌäp-tō-kə-ˈnet-ik, -kī-\ *adj* [Gk *optos* + *kinetic*] : of, relating to, or involving movements of the eyes

op-tom-e-trist \äp-ˈtäm-ə-trəst\ *n* : a specialist in optometry — compare OPHTHALMOLOGIST, OPTICIAN

op-tom-e-try \-trē\ *n* [Gk *optos* (verbal of *opsesthai* to be going to see) + ISV *-metry* — more at OPTIC] : the art or profession of examining the eye for defects and faults of refraction and prescribing correctional lenses or exercises but not drugs or surgery — **op-to-met-ric** \ˌäp-tə-ˈme-trik\ *also* **op-to-met-ri-cal** \-tri-kəl\ *adj*

opt out *vi* : to choose not to participate in something — often used with *of* ⟨impossible for anybody to *opt out* of politics —Brian Crozier⟩

op-u-lence \ˈäp-yə-lən(t)s\ *n* **1** : WEALTH, AFFLUENCE **2** : ABUNDANCE, PROFUSION

op-u-lent \-lənt\ *adj* [L *opulentus*, fr. *ops* power, help; akin to L *opus* work] : exhibiting or characterized by opulence: as **a** : having a large estate or property : WEALTHY ⟨hoping to marry an ~ widow⟩ **b** : amply or plentifully provided or fashioned often to the point of ostentation ⟨living in ~ comfort⟩ ***syn*** **1** see RICH ***ant*** destitute, indigent **2** see LUXURIOUS — **op-u-lent-ly** *adv*

opun-tia \ō-ˈpən-ch(ē-)ə\ *n* [L, a plant, fr. fem. of *opuntius* of Opus, fr. *Opunt-*, *Opus* Opus, ancient city in Greece] : PRICKLY PEAR

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